

Letter Report:

Pollutant Concentration Percentile Estimates
to Support Phase II Regulations for Biosolids
Use or Disposal

Submitted to:

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I. INTRODUCTION

In February, 1993, the Environmental Protection Agency (EPA) promulgated limits for nine toxic pollutants in biosolids. These limits, which were issued by EPA under the authority of section 405(d) Clean Water Act, as amended, are referred to as the “Round 1” regulation for use and disposal of biosolids. In May, 1993, the EPA submitted to the court a list of 31 candidate pollutants for “Round 2” regulations. This letter report presents percentile estimates from the empirical distributions three “Round 2” pollutants. These pollutants are as follows: (1) total toxic equivalents (TEQ) for dioxins and furans; (2) total TEQs for co-planar polychlorinated biphenyls (PCBs), and total TEQs for dioxins, furans, and co-planer PCBs. In addition to empirical estimates for these three regulated pollutants, this report provides estimates of the number of Publicly Owned Treatment Works (POTWs) expected to exceed proposed limitations and the number of POTWs in the Nation disposing of biosolids via compost brokers/contractors. Estimates are based on 1988 data.

Dioxin and furan data analyzed to produce these empirical concentration percentile estimates are from the EPA’s 1988 National Sewage Sludge Survey (NSSS). The Association of Metropolitan Sewage Authorities (AMSA) supplied PCB data for 74 facilities. Section II briefly describes the NSSS and AMSA data. Data conventions are presented in Section III. Section IV provides the statistical methodology employed to produce the percentile estimates. Section V presents tabulated percentile estimates of the regulated pollutants and graphically displays the empirical cumulative distribution functions. Section V also contains estimates of the percentage of POTWs expected to exceed proposed limitations. Finally, Section VI lists estimates of the number of POTWs in the Nation in 1988 practicing distribution and marketing to compost brokers/contractors. Estimates of dry metric tons of biosolids marketed to compost brokers/contracts are also provided in Section VI.

II. ANALYTICAL DATA

To support “Round 1 and 2” regulatory development efforts, the EPA’s 1988 NATIONAL SEWAGE SLUDGE SURVEY (NSSS) collected biosolids quality and pollutant occurrence data from a national probability sample of POTWs practicing at least secondary treatment of wastewater. Operationally, secondary treatment was defined as a primary clarifier process followed by biological treatment and secondary clarification. In 1988, 11,407 POTWs in the 50 States, Puerto Rico, and the District of Columbia met these criteria.

A statistical probability sample of 208 POTWs in the contiguous states and the District of Columbia comprised the analytical component of the 1988 NSSS. These POTWs were randomly drawn from secondary or higher treatment POTWs that were categorized into one of four strata based on their average daily flow of influent wastewater. These strata are defined as follows:

- 1) Flow greater than 100 million gallons per day (MGD)
- 2) Flow more than 10 MGD but less than or equal to 100 MGD

- 3) Flow more than 1 MGD but less than or equal to 10 MGD
- 4) Flow less than or equal to 1 MGD.

EPA contract personnel collected biosolids samples from 180 POTWs in the analytical component of the NSSS. Samples were collected just prior to use or disposal of the biosolids. All sample collection and preservation was conducted according to protocol. Contract laboratories analyzed each biosolids sample for 412 analytes. Method 1613 measured dibenzofurans and dioxins. Chemical analysis methods were either developed, chosen, or adapted to allow for the most reliable and accurate measurement of the subject analytes in the biosolids matrix.

A more detailed discussion the NSSS sampling plan, POTWs, and data are included in a November, 1992 final report entitled "Statistical Support Documentation for the 40 CFR, Part 503 Final Standards for the Use or Disposal of Sewage Sludge."

AMSA supplied concentrations of co-planar PCBs in biosolids from 74 POTWs. Analytical method information is not available for the co-planar PCB concentrations. These measurements were voluntarily submitted to AMSA. It is anticipated that biosolid samples were from secondary or higher treatment of wastewater as secondary treatment is the minimum standard for POTWs.

III. DATA CONVENTIONS

A total of 208 POTWs were selected for sampling as part of the analytical component of the EPA's 1988 NSSS. However, 32 POTWs were excluded from statistical analyses because biosolid samples were not obtained after the completion of secondary treatment of wastewater. Table 1 lists POTWs selected for the NSSS but excluded from the statistical analyses.

National concentration estimates of toxic equivalence of dioxins and furans were calculated from a sample of 174 POTWs. Biosolid samples from SurveyIDs 23-07-036 (Episode=1554) and 35-05-012 (Episode=1561) were not analyzed for the dioxin/furans during the NSSS. Therefore, dioxin /furan estimates, generated from a sample of 174 POTWs, apply to a population of 7,714 POTWs.

Prior to calculating the national estimates of dioxin and furans, pollutant concentrations were aggregated on a POTW basis to form one concentration value per POTW for each pollutant. For POTWs with multiple samples, the pollutant concentrations were averaged together, using a weighted average based on the dry weight of biosolids disposed by the treatment train associated with each sample. Each aggregate concentration is considered to be detected above the pollutants minimum level if at least one of the samples was detected above the minimum level of detection. If a pollutant was not measured above the minimum level, one half the minimum level value was used in estimation procedures as a concentration value.

The dioxins and furans estimates are reported in aggregate as well as individually. Aggregates were mathematically created using the following method. After each congener was aggregated on a

POTW basis, the concentration of the congener for each POTW was multiplied by the congener's corresponding 1989 NATO Toxicity Equivalence Factor (TEF). Table 2 lists the applied TEF's that are based on the toxicity of 2, 3, 7, 8 TCDD. The resulting TEQ adjusted values were then summed over all congeners for each POTW to create the POTW composite dioxi/furan TEQ concentration.

The mathematic expression for determining a POTW's TEQ is:

$$TEQ = \sum_{i=1}^n (Congener_i \times TEF_i) + (Congener_j \times TEF_j) + \dots + (Congener_n \times TEF_n)$$

AMSA data provided measurements on four co-planar PCBs. These coplanar arochlors are: 77-TPCB, 81-TPCB, 126-PePCB and 169-HxPCB. The toxic equivalent factors used for these PCBs are 1998 World Health Organization (WHO) factors. Table 3 records these factors. PCBs were also mathematically aggregated. These aggregates were generated as described above.

IV. STATISTICAL METHODS-PERCENTILE ESTIMATES

TOTAL TEQs for DIOXIN and FURANS

EPA calculated percentile estimates using the nonparametric, weighted cumulative distribution function (CDF) technique. This method is described below.

Denote the dry weight, toxic equivalent concentration of a given pollutant in the sampled biosolid from the j^{th} POTW in the i^{th} survey flow stratum as X_{ij} . The values of the variable X_{ij} are then sorted in order of increasing TEQ concentration. The values of the adjusted survey weights (W_i) associated with the ordered values of X_{ij} are then summed until the first occurrence of p .

If X_p is defined as the concentration of the p^{th} percentile then,

$$X_p = F(X) \leq p \quad \text{where} \quad F(X) = \sum_{i=1}^4 w_i F_i(X)$$

with

$$F_i = \sum_{j=1}^{n_{ij}} \frac{I(X_{ij} - x)}{n_{ij}}$$

and $I(X_{ij} - x) = 1$ if $X_{ij} - x$ for $x \leq 0$
 $= 0$ otherwise .

To determine the TEQ pollutant concentration associated with the p^{th} percentile, an inverse function was applied to the cumulative distribution function. Define the p^{th} percentile as $F_X(x_p)$ such that $P[X \leq x_p] \geq p/100$. The inverse of this function $F^{-1}(p)$, is the smallest value of x satisfying $F_X(x) \geq p$ where p is the desired percentile point (P) divided by 100.

TOTAL TEQs for CO-PLANAR PCBs

As PCBs were assumed to be sampled with equal probability, the weight associated with each POTW in the AMSA survey was 1/74. Thus, the 74 TEQs were sorted in increasing order. The p^{th} percentile from the empirical cumulative distribution of total TEQs for co-planar PABs is estimated as X_p where

$$X_p = F(X) \leq p \quad \text{where} \quad F(X) = \sum_{i=1}^{74} \frac{I(X_i - x)}{74}$$

and $I(X_i - x) = 1$ if $X_i - x$ for $x \leq 0$
 $= 0$ otherwise .

Because the cumulative distribution created by application of the formula in the previous section is empirical, integer valued percentile points are not always realized. The convention applied to determine the TEQ concentration associated with the p^{th} integer percentile from the empirical distribution function was to determine the smallest TEQ concentration value x such that $F_X(x) \geq p$. This value was denoted x_{p+} and is the q^{th} ordered TEQ concentration. The next smallest TEQ concentration from x_{p+} , or the concentration associated with the $(q-1)$ st ordered TEQ concentration was then identified. The TEQ concentration value for the p^{th} percentile was obtained using linear interpolation between the q^{th} and $(q-1)$ values.

TOTAL TEQs for DIOXIN AND FURAN and CO-PLANAR PCBs

To generate empirical cumulative distribution estimates of total PCB and dioxin and furan TEQs, EPA assumes that TEQs for total dioxin and furans and co-planar PCBs are correlated in biosolid samples. This assumption is predicated on the fact that the co-planar PCBs tested by AMSA facilities are “dioxin-like.” The co-planar structures of the evaluated PCBs afford physical properties and toxic responses to polychlorinated dibenzo-p-dioxins and furans.

Using this similarity in chemical properties, EPA created an empirical cumulative distribution of total TEQs by matching cumulative distribution points for the TEQs for dioxin and furans with the cumulative distribution points for the distribution of TEQs for co-planar PCBs. To do this, EPA generated estimates for each percentile, from 1 to 100, for the TEQs of dioxin and furans. The same methods were applied to estimates each percentile from 1 to 100 for the empirical distribution of co-planar PCB TEQs. EPA estimated the pth percentile for the distribution of total TEQs by summing the pth TEQ estimates from the empirical distribution of dioxin and furan with that from the co-planar PCB empirical distribution.

V. POLLUTANT CONCENTRATION PERCENTILE ESTIMATES

Table 4 presents TEQ concentration percentile estimates for dioxins and furans from the 1988 National Sewage Sludge Survey (NSSS.) For each pollutant, the tables report the following: pollutant type, unit of measure, sample size, an estimate of the national percent detect, the observed maximum, and the 99th, 98th, 95th, 90th and median percentiles estimated from empirical national, cumulative distributions of pollutant concentrations. The column labeled “Sample size” records the number of POTWs in the NSSS from which data were used to generate the reported estimates.

Table 4 is subtitled “Nonparametric Substitution Method Estimation Procedure- Nondetects Set to Half of the Minimum Level.” The nonparametric estimation procedure is that described in Section IV. The 95th percentile estimates of total dioxin and furan TEQs is 254 ng/kg of dry weight of biosolids.

Table 5 lists descriptive statistics and percentile estimates of co-planar PCB TEQs. The estimated 95th percentile of the empirical distribution of co-planar PCB TEQs is 62. The median or 50th percentile from this distribution is 9.27 ng/kg.

Values for the 100 percentile points of the cumulative distribution of co-planar PCBs and dioxin and furans are listed in Table 6. The proposed limit of 300 IS obtained by summing the 95th percentile estimate for dioxin and furan TEQs with the 95th percentile estimate for “dioxin-like” co-planar PCBs. Viewing this total TEQ cumulative distribution for dioxin/furan and dioxin like PCBs indicates that the probability of exceeding the limit is 6 percent.

Figure 1 presents the empirical distributions of TEQs for dioxin and furans, for coplanar PCBs and for the total TEQs of dioxin/furans and dioxin like PCBs.

VI. NATIONAL ESTIMATES - POTWs Distribution and Marketing to Compost Brokers/Contractors

EPA's 1988 NSSS collected information from POTWs regarding the use and disposal practices. Nineteen POTWs indicated that they marketed biosolids to compost brokers/contractors during 1988. These 19 POTWs represent 146 POTWs in the Nation. These 146 POTWs are estimated to have disposed of 127,950 dry metric tons of biosolids in this fashion. As Table 7 indicates, 95 of the estimated 146 POTWs distributing and marketing to compost brokers/contractors are POTWs treating less than one million gallons of waste water per day. Thus, the smallest POTWs account for an estimated 65 percent of the POTWs using this method of biosolids use or disposal. However, it is the 14 POTWs from the category of POTWs that treat between 10 and 100 million gallons of wastewater per day that dispose of the largest amount of biosolids using this method. Although the 14 POTWs in this size category represent approximately 10% of the POTWs in the Nation using this regulated use/disposal method, they account for 46 percent of the dry metric tons of biosolids disposed of using this method.

TABLE 1

LISTING OF POTW_s EXCLUDED FROM PERCENTILE ESTIMATION

SURVEYID	Episode	Reason	Flow Stratum
12-49-455	0	Ineligible/Out of Business	1
21-25-234	0	Not sampled	2
25-38-345	0	Ineligible/Out of Business	2
25-50-472	1386	Only primary sludge sampled	2
31-18-140	1477	Data not entered into database	3
31-23-206	1398	Only primary sludge sampled	3
41-24-215	0	Not sampled	4
41-36-312	0	Not sampled	4
45-02-005	0	Wastewater Stabilization pond (WWSP)	4
45-11-064	0	WWSP	4
45-13-083	0	WWSP	4
45-13-089	0	WWSP	4
45-14-092	0	WWSP	4
45-15-112	0	WWSP	4
45-16-130	0	WWSP	4
45-17-131	0	WWSP	4
45-19-154	0	WWSP	4
45-23-208	0	WWSP	4
45-24-220	0	WWSP	4
45-25-229	0	Ineligible/Out of Business	4
45-25-231	0	WWSP	4
45-26-237	0	WWSP	4
45-28-246	0	WWSP	4
45-29-248	0	WWSP	4

SURVEYID	Episode	Reason	Flow Stratum
45-30-253	0	WWSP	4
45-37-339	0	Not sampled	4
45-42-387	0	Ineligible/Out of Business	4
45-42-392	1488	Ineligible/Out of Business	4
45-45-415	0	WWSP	4
45-45-423	0	Not sampled	4
45-50-463	0	Not sampled	4
45-50-474	0	WWSP	4

TABLE 2

1989 NATO TOXICITY EQUIVALENCY FACTORS

CONGENER	TEF
Octachlorodibenzo-p-dioxin	0.001
Octachlorodibenzofuran	0.001
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	0.010
1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.010
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	0.100
1,2,3,4,7,8-Hexachlorodibenzofuran	0.100
1,2,3,4,7,8,9-Heptachlorodibenzofuran	0.010
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	0.10
1,2,3,6,7,8-Hexachlorodibenzofuran	0.100
1,2,3,7,8-Pentachlorodibenzo-p-dioxin	0.500
1,2,3,7,8-Pentachlorodibenzofuran	0.050
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	0.100
1,2,3,7,8,9-Hexachlorodibenzofuran	0.100
2,3,4,6,7,8-Hexachlorodibenzofuran	0.100
2,3,4,7,8-Pentachlorodibenzofuran	0.500
2,3,7,8-Tetrachlorodibenzo-p-dioxin	1.000
2,3,7,8-Tetrachlorodibenzofuran	0.100

TABLE 3

THE TEF SCHEME FOR TEQ_{DEP} -WHO₉₈

“Dioxin-like” PCB(s)	TEF
PCB-77	0.0001
PCB-81	0.0001
PCB-126	0.1
PCB-169	0.01

TABLE 4
NATIONAL POLLUTANT CONCENTRATION PERCENTILE ESTIMATES FROM THE NATIONAL SEWAGE SLUDGE SURVEY
Candidate Pollutants for Round 2 Regulations
Nonparametric Substitution Method Estimation Procedure - Nondetects Set to Half the Minimum Level

Pollutant	Type	Unit	Sample Size	POTWs	Percent Detect	Mean	Standard Deviation	Observed Maximum
di oxin sa	Di oxin s	NG/KG	174	7714	0	71.20	167.00	1760.00
di oxin sb	Di oxin s	NG/KG	174	7714	100	71.20	167.00	1760.00
OCTACHLORODI BENZO- P- DI OXIN	Di oxin s	NG/KG	174	7714	100	11.70	59.20	905.00
OCTACHLORODI BENZOFURAN	Di oxin s	NG/KG	174	7714	80	0.66	4.38	69.50
1, 2, 3, 4, 6, 7, 8- HEPTACHLORODI BENZO- P- DI OXIN	Di oxin s	NG/KG	174	7714	98	9.51	37.00	525.00
1, 2, 3, 4, 6, 7, 8- HEPTACHLORODI BENZOFURAN	Di oxin s	NG/KG	174	7714	71	2.01	6.59	71.00
1, 2, 3, 4, 7, 8- HEXACHLORODI BENZO- P- DI OXIN	Di oxin s	NG/KG	174	7714	25	2.61	5.81	73.70
1, 2, 3, 4, 7, 8- HEXACHLORODI BENZOFURAN	Di oxin s	NG/KG	174	7714	43	6.06	21.00	150.00
1, 2, 3, 4, 7, 8, 9- HEPTACHLORODI BENZOFURAN	Di oxin s	NG/KG	174	7714	26	0.28	0.71	8.42
1, 2, 3, 6, 7, 8- HEXACHLORODI BENZO- P- DI OXIN	Di oxin s	NG/KG	174	7714	49	4.22	10.50	73.70
1, 2, 3, 6, 7, 8- HEXACHLORODI BENZOFURAN	Di oxin s	NG/KG	174	7714	35	2.32	5.51	73.70
1, 2, 3, 7, 8- PENTACHLORODI BENZO- P- DI OXIN	Di oxin s	NG/KG	174	7714	18	7.26	25.30	368.00
1, 2, 3, 7, 8- PENTACHLORODI BENZOFURAN	Di oxin s	NG/KG	174	7714	22	0.79	2.60	36.80
1, 2, 3, 7, 8, 9- HEXACHLORODI BENZO- P- DI OXIN	Di oxin s	NG/KG	174	7714	39	3.10	6.43	73.70
1, 2, 3, 7, 8, 9- HEXACHLORODI BENZOFURAN	Di oxin s	NG/KG	174	7714	16	2.43	8.49	126.00
2, 3, 4, 6, 7, 8- HEXACHLORODI BENZOFURAN	Di oxin s	NG/KG	174	7714	27	2.17	5.20	73.70
2, 3, 4, 7, 8- PENTACHLORODI BENZOFURAN	Di oxin s	NG/KG	174	7714	26	8.78	27.20	368.00
2, 3, 7, 8- TETRACHLORODI BENZO- P- DI OXIN	Di oxin s	NG/KG	174	7714	16	6.16	9.34	116.00
2, 3, 7, 8- TETRACHLORODI BENZOFURAN	Di oxin s	NG/KG	174	7714	64	1.14	1.12	8.70

Pollutant	99th Percentile	98th Percentile	95th Percentile	90th Percentile	50th Percentile
di oxin sa	542.00	522.00	254.00	148.00	34.30
di oxin sb	542.00	522.00	254.00	148.00	34.30
OCTACHLORODI BENZO- P- DI OXIN	127.00	116.00	33.70	15.90	3.32
OCTACHLORODI BENZOFURAN	5.04	4.75	3.31	0.55	0.08
1, 2, 3, 4, 6, 7, 8- HEPTACHLORODI BENZO- P- DI OXIN	103.00	73.70	27.90	14.00	3.35
1, 2, 3, 4, 6, 7, 8- HEPTACHLORODI BENZOFURAN	31.50	27.60	5.72	3.09	0.43
1, 2, 3, 4, 7, 8- HEXACHLORODI BENZO- P- DI OXIN	17.90	16.20	13.40	4.33	1.50
1, 2, 3, 4, 7, 8- HEXACHLORODI BENZOFURAN	109.00	73.20	15.30	10.20	1.60
1, 2, 3, 4, 7, 8, 9- HEPTACHLORODI BENZOFURAN	1.54	1.45	1.19	0.58	0.12
1, 2, 3, 6, 7, 8- HEXACHLORODI BENZO- P- DI OXIN	58.50	47.70	12.60	8.43	1.80
1, 2, 3, 6, 7, 8- HEXACHLORODI BENZOFURAN	15.00	15.00	10.20	3.87	1.10
1, 2, 3, 7, 8- PENTACHLORODI BENZO- P- DI OXIN	66.70	60.10	27.60	8.50	2.75
1, 2, 3, 7, 8- PENTACHLORODI BENZOFURAN	7.15	6.06	3.63	1.58	0.30
1, 2, 3, 7, 8, 9- HEXACHLORODI BENZO- P- DI OXIN	19.60	17.90	12.70	5.44	1.60
1, 2, 3, 7, 8, 9- HEXACHLORODI BENZOFURAN	19.50	14.80	6.81	3.65	1.15
2, 3, 4, 6, 7, 8- HEXACHLORODI BENZOFURAN	14.80	13.10	6.65	3.52	1.25
2, 3, 4, 7, 8- PENTACHLORODI BENZOFURAN	74.50	68.00	45.50	19.10	3.00
2, 3, 7, 8- TETRACHLORODI BENZO- P- DI OXIN	27.00	25.70	17.70	12.00	3.55
2, 3, 7, 8- TETRACHLORODI BENZOFURAN	5.07	5.01	3.77	2.40	0.85

a Composites considered a detect if all individual congeners or PCBs are measured above the minimum level.

b Composites considered a detect if at least one congener or PCB is measured above the minimum level.

* Dioxins and Furans Reported as Toxic Equivalents

Note: Three significant figures are reported

TABLE 5

100 PERCENTILE CUMULATIVE DISTRIBUTION FUNCTION
FOR CO-PLANAR PCB TEQS

Percentile	Total TEQs for Co-planar PCBs
100	305.00
99	272.00
98	196.00
97	117.00
96	86.50
95	62.10
94	52.30
93	51.10
92	46.30
91	43.80
90	42.60
89	42.60
88	42.50
87	37.30
86	33.10
85	31.30
84	30.00
83	27.90
82	26.30
81	25.80
80	25.80
79	25.30
78	24.90
77	24.80
76	22.80

Percentile	Total TEQs for Co-planar PCBs
75	21.80
74	21.00
73	19.90
72	19.40
71	18.90
70	18.60
69	18.50
68	18.40
67	18.20
66	18.00
65	17.70
64	17.70
63	17.60
62	17.50
61	17.40
60	16.10
59	15.20
58	15.10
57	14.60
56	12.70
55	11.20
54	11.00
53	10.00
52	9.49
51	9.29
50	9.27
49	8.94
48	8.47

Percentile	Total TEQs for Co-planar PCBs
47	8.63
46	8.55
45	8.41
44	8.16
43	7.89
42	7.74
41	7.60
40	7.52
39	7.47
38	7.35
37	7.20
36	7.09
35	7.03
34	6.94
33	6.44
32	6.01
31	5.84
30	5.83
29	5.76
28	5.70
27	5.68
26	5.60
25	5.53
24	5.40
23	5.12
22	4.96
21	4.82
20	4.73

Percentile	Total TEQs for Co-planar PCBs
19	4.70
18	4.65
17	4.61
16	4.57
15	4.45
14	4.42
13	4.41
12	4.35
11	4.16
10	4.05
9	3.94
8	3.81
7	3.53
6	3.46
5	3.04
4	2.06
3	1.77
2	1.56
1	1.07

TABLE 6

ESTIMATED 100 PERCENTILE CUMULATIVE DISTRIBUTION FUNCTION
FOR DIOXINS, FURANS, AND CO-PLANAR PCB TEQS

Percentile	Total TEQs for Co-planer PCBs	Total TEQs for Dioxins and Furans	Dioxins, Furans, and Co-planar PCBs	Flag (if observations >300)
100	305.00	1760.00	2065.00	>
99	272.00	542.00	814.00	>
98	196.00	522.00	718.00	>
97	117.00	311.00	428.00	>
96	86.50	301.00	387.50	>
95	62.10	254.00	316.10	>
94	52.30	227.00	279.30	
93	51.10	226.00	270.10	
92	46.30	217.00	263.30	
91	43.80	207.00	250.80	
90	42.60	148.00	190.60	
89	42.60	136.00	178.60	
88	42.50	111.00	153.50	
87	37.30	106.00	143.30	
86	33.10	102.00	135.10	
85	31.30	74.50	105.80	
84	30.00	68.50	98.50	
83	27.90	67.70	95.60	
82	26.30	58.70	85.00	
81	25.80	56.90	82.70	
80	25.80	55.50	81.30	
79	25.30	54.20	79.50	
78	24.90	53.70	78.60	
77	24.80	52.30	77.10	

Percentile	Total TEQs for Co-planer PCBs	Total TEQs for Dioxins and Furans	Dioxins, Furans, and Co-planar PCBs	Flag (if observations >300)
76	22.80	52.20	75.00	
75	21.80	51.80	73.60	
74	21.00	51.00	72.00	
73	19.90	47.50	67.40	
72	18.40	47.40	66.80	
71	18.90	47.10	66.00	
70	18.60	46.80	65.40	
69	18.50	46.80	65.30	
68	18.40	46.50	64.90	
67	18.20	46.00	64.20	
66	18.00	45.00	63.00	
65	17.70	44.60	62.30	
64	17.70	43.10	60.80	
63	17.60	41.60	59.20	
62	17.50	40.80	58.30	
61	17.40	40.80	58.20	
60	16.10	40.40	56.50	
59	15.20	40.10	55.30	
58	15.10	39.00	54.10	
57	14.60	38.50	53.10	
56	12.70	37.90	50.60	
55	11.20	37.70	48.90	
54	11.00	37.20	48.20	
53	10.00	36.70	46.70	
52	9.49	36.50	45.99	
51	9.29	34.90	44.19	
50	9.27	34.30	43.57	

Percentile	Total TEQs for Co-planer PCBs	Total TEQs for Dioxins and Furans	Dioxins, Furans, and Co-planar PCBs	Flag (if observations >300)
49	8.94	33.90	42.84	
48	8.74	32.80	41.54	
47	8.63	32.60	41.23	
46	8.55	32.40	40.95	
45	8.41	32.20	40.16	
44	8.16	31.50	39.66	
43	7.89	27.40	35.29	
42	7.74	25.80	33.54	
41	7.60	24.50	32.10	
40	7.52	24.50	32.02	
39	7.47	24.10	31.57	
38	7.35	23.50	30.85	
37	7.20	22.50	29.70	
36	7.09	20.90	27.99	
35	7.03	17.30	24.33	
34	6.94	17.10	24.04	
33	6.44	16.80	23.24	
32	6.01	16.50	22.51	
31	5.84	16.00	21.84	
30	5.83	16.00	21.83	
29	5.76	15.90	121.66	
28	5.70	15.70	21.40	
27	5.68	15.50	21.18	
26	5.60	15.50	21.10	
25	5.53	15.30	20.83	
24	5.40	15.10	20.50	
23	5.12	14.50	19.62	

Percentile	Total TEQs for Co-planer PCBs	Total TEQs for Dioxins and Furans	Dioxins, Furans, and Co-planar PCBs	Flag (if observations >300)
22	4.96	14.00	18.96	
21	4.82	13.90	18.72	
20	4.73	13.10	17.83	
19	4.70	11.50	16.20	
18	4.65	10.30	14.95	
17	4.61	9.61	14.22	
16	4.57	7.79	12.36	
15	4.45	7.38	11.83	
14	4.42	4.34	8.76	
13	4.41	3.84	8.25	
12	4.35	3.13	7.48	
11	4.16	3.04	7.20	
10	4.05	2.32	6.37	
9	3.94	2.28	6.22	
8	3.81	1.63	5.44	
7	3.53	1.24	4.77	
6	3.46	0.98	4.44	
5	3.04	0.88	3.94	
4	2.06	0.67	2.73	
3	1.77	0.62	2.39	
2	1.56	0.55	2.11	
1	1.07	0.28	1.35	

TABLE 7

ESTIMATED TOTAL DRY BIOSOLIDS IN METRIC TONS FOR COMPOST BROKERS'
END USE BY REPORTED FLOW GROUP

Flow Group	# of POTWs	Metric Tons
>100 mgd	4	11,499.45
10< Flow <= 100	14	58,708.97
1< Flow <= 10	33	28,492.17
Flow <= 1	95	29,249.64
Total	146	127,950.22

Empirical Cumulative TEQ Distribution Functions

